Characterization and Validation of Ozone Pollution Episodes Using Aura Measurements and Assimilated Models

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Aura Validation Workshop
Boulder, Colorado
September 11, 2006

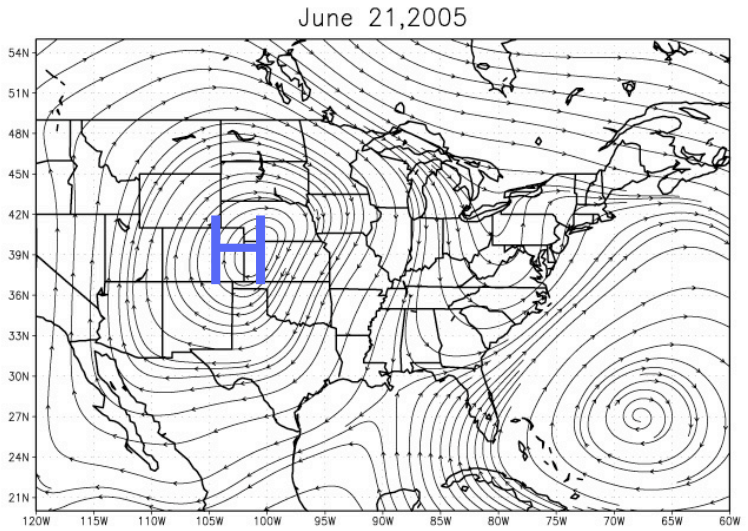
Two Periods of Investigation

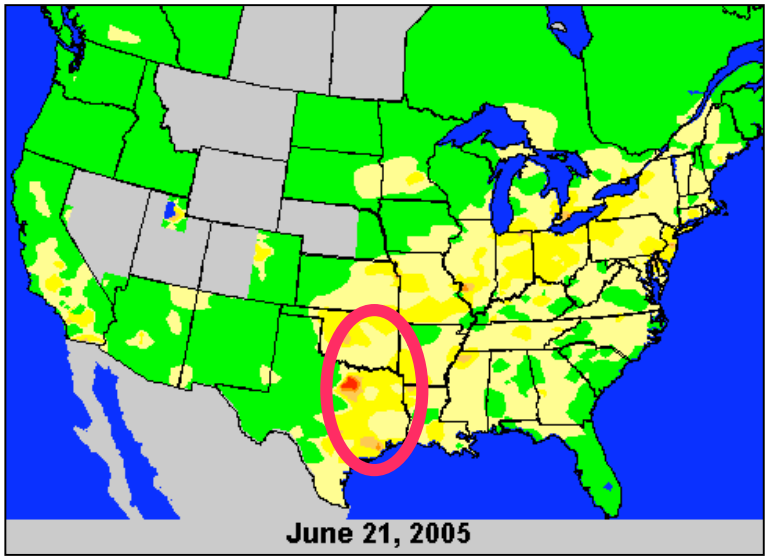
- Late June 2005
  - Use of OMI Tropospheric Ozone to Characterize Episode

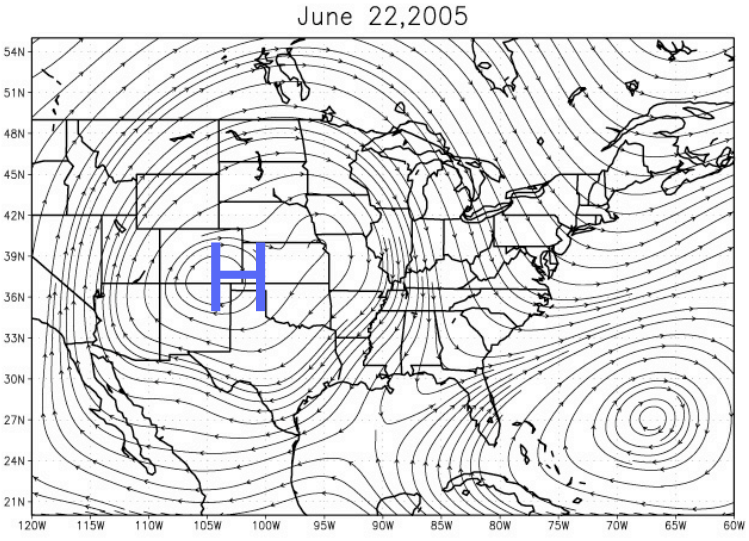
- August 2006

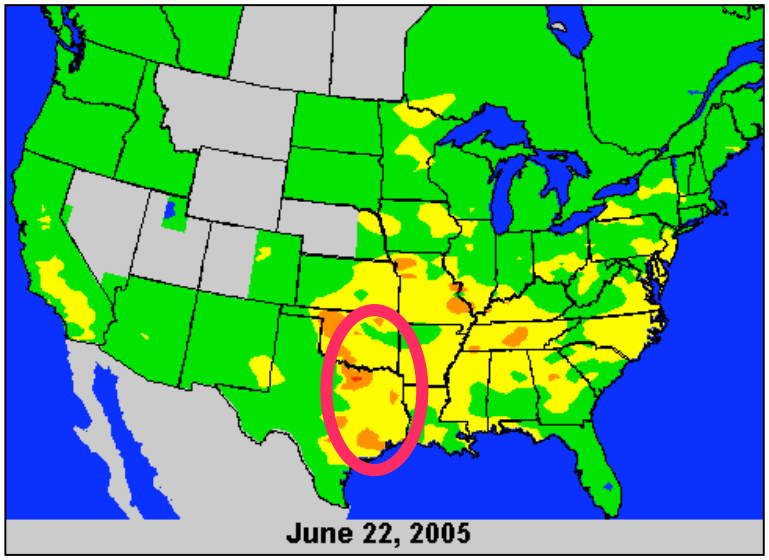
  Data Assimilation Using Satellites to Observe Ozone Distribution

Favorable Conditions for Pollution Formation over East Texas During June 21-24, 2005

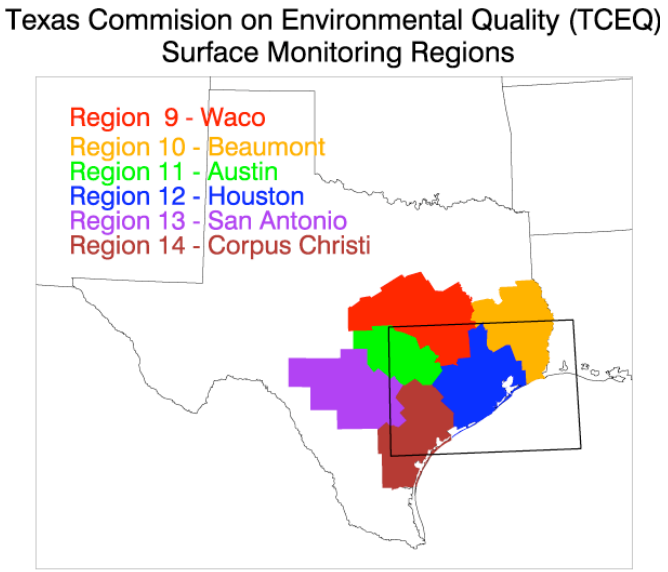


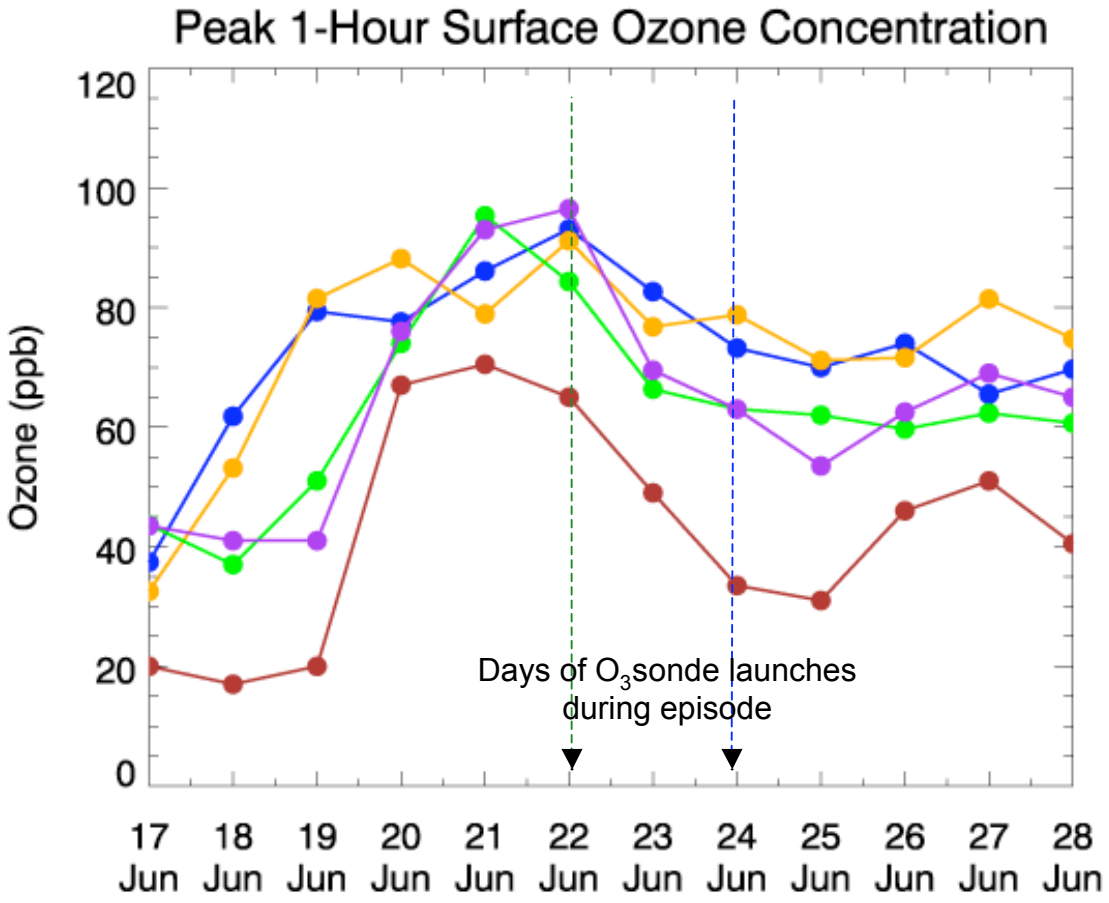






Regional Ozone Pollution Episode over Southeast Texas during late June 2005





June 22, 2005: Aerial View of Houston Shows Hazy Conditions

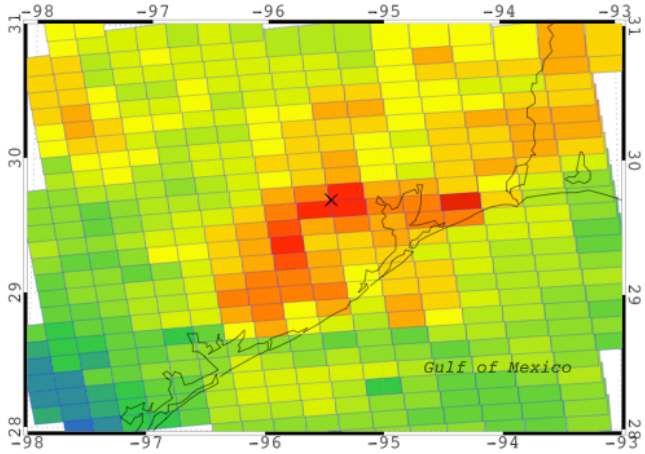
Landing Approach: 2800 m

Thick haze at 1860 m

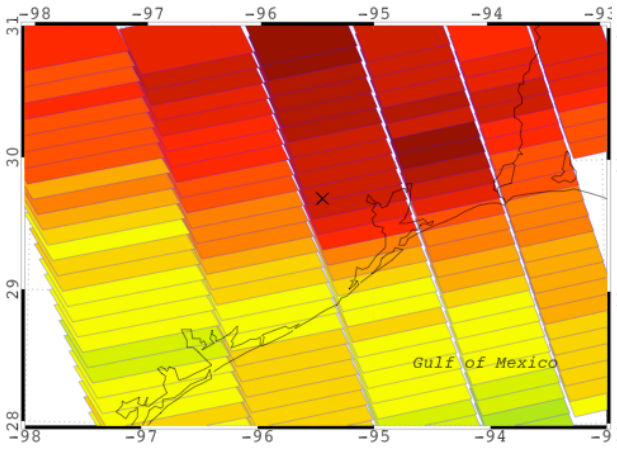
City of Houston from 820 m

Out of Haze at 200 m

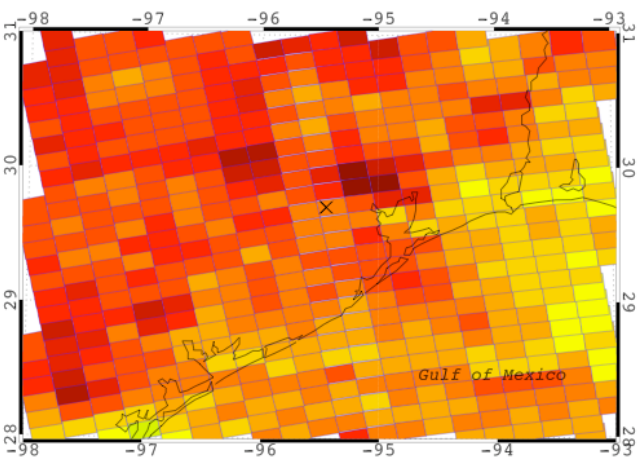
Variable OMI Pixel Size Complicates Utility of Data



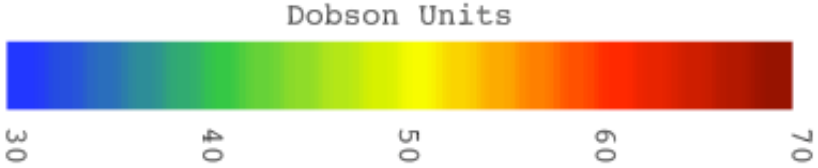
June 22



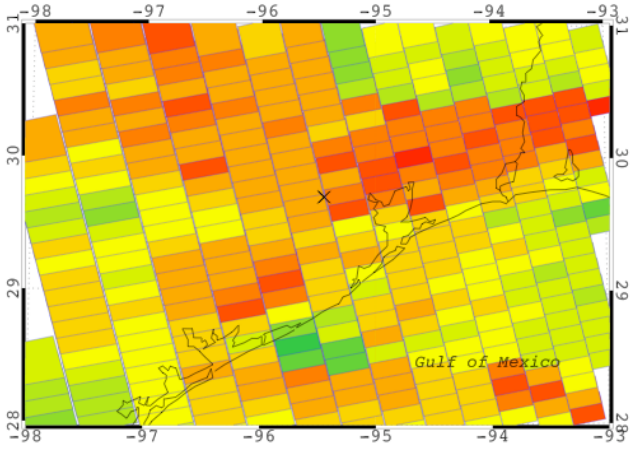
June 23



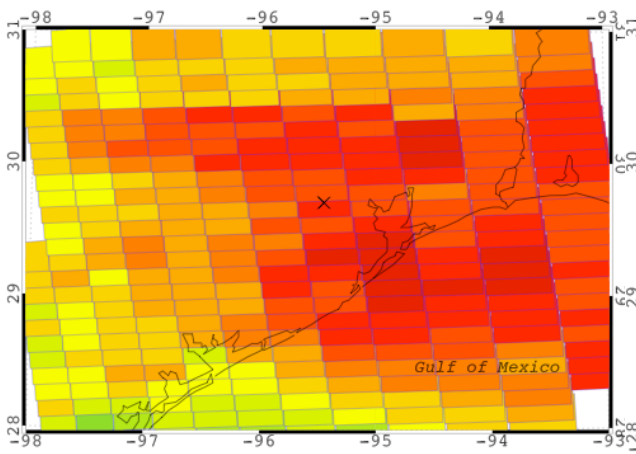
June 24



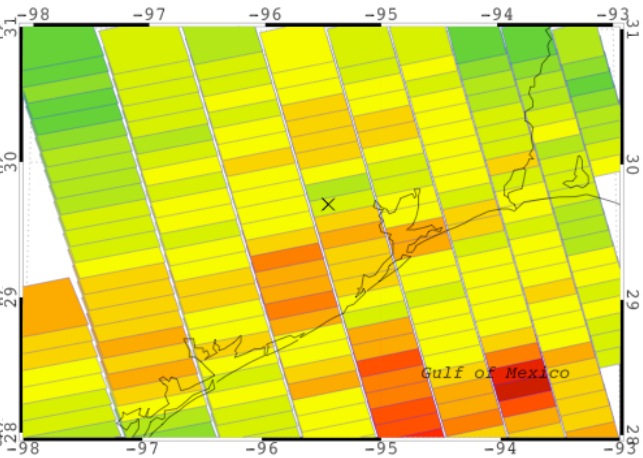
OMI/GFS TOR Over Houston



June 19



June 20



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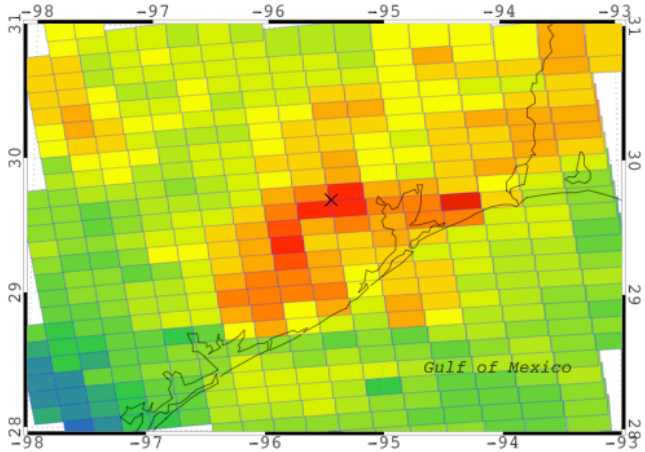
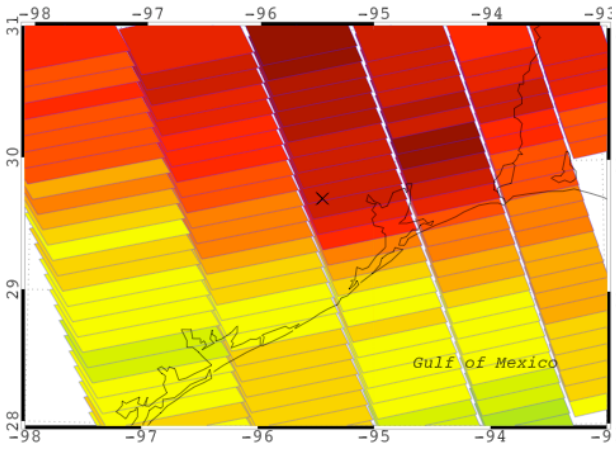


June 22



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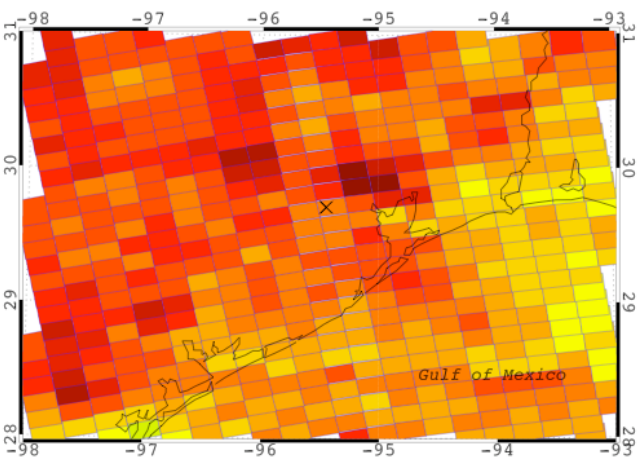
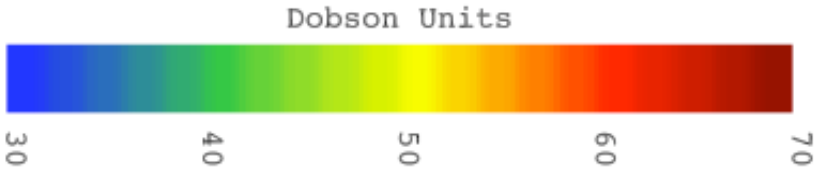
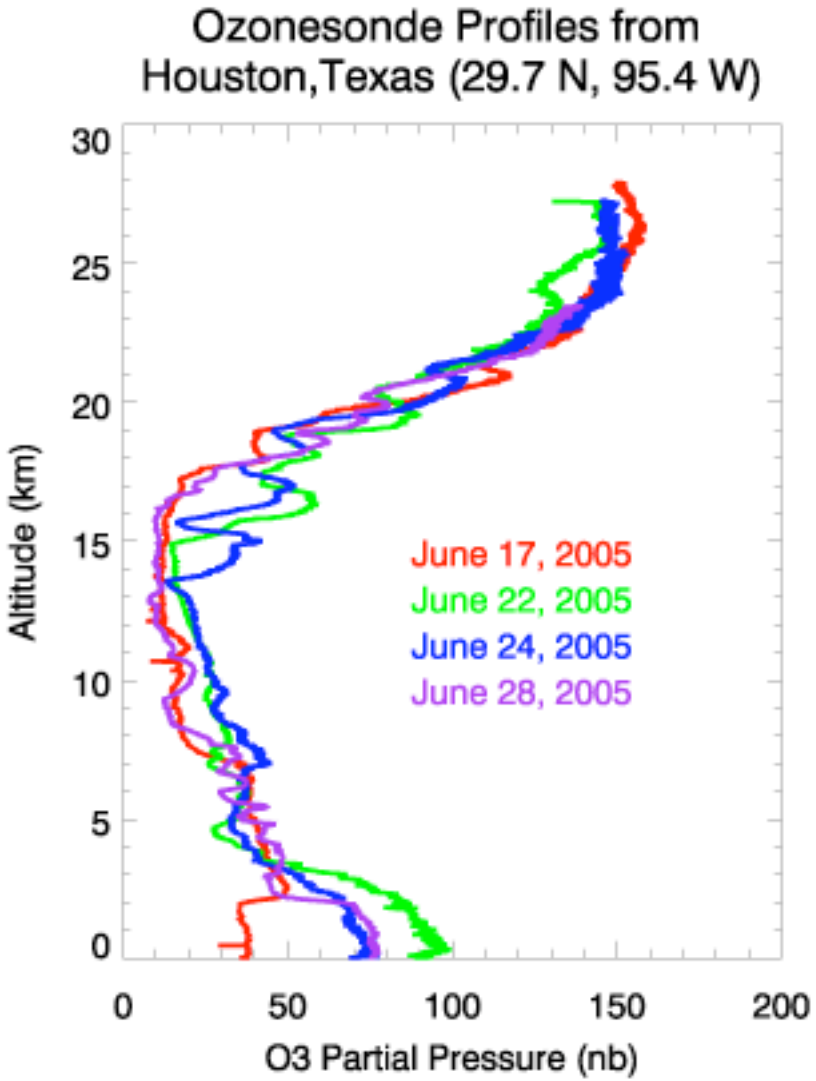


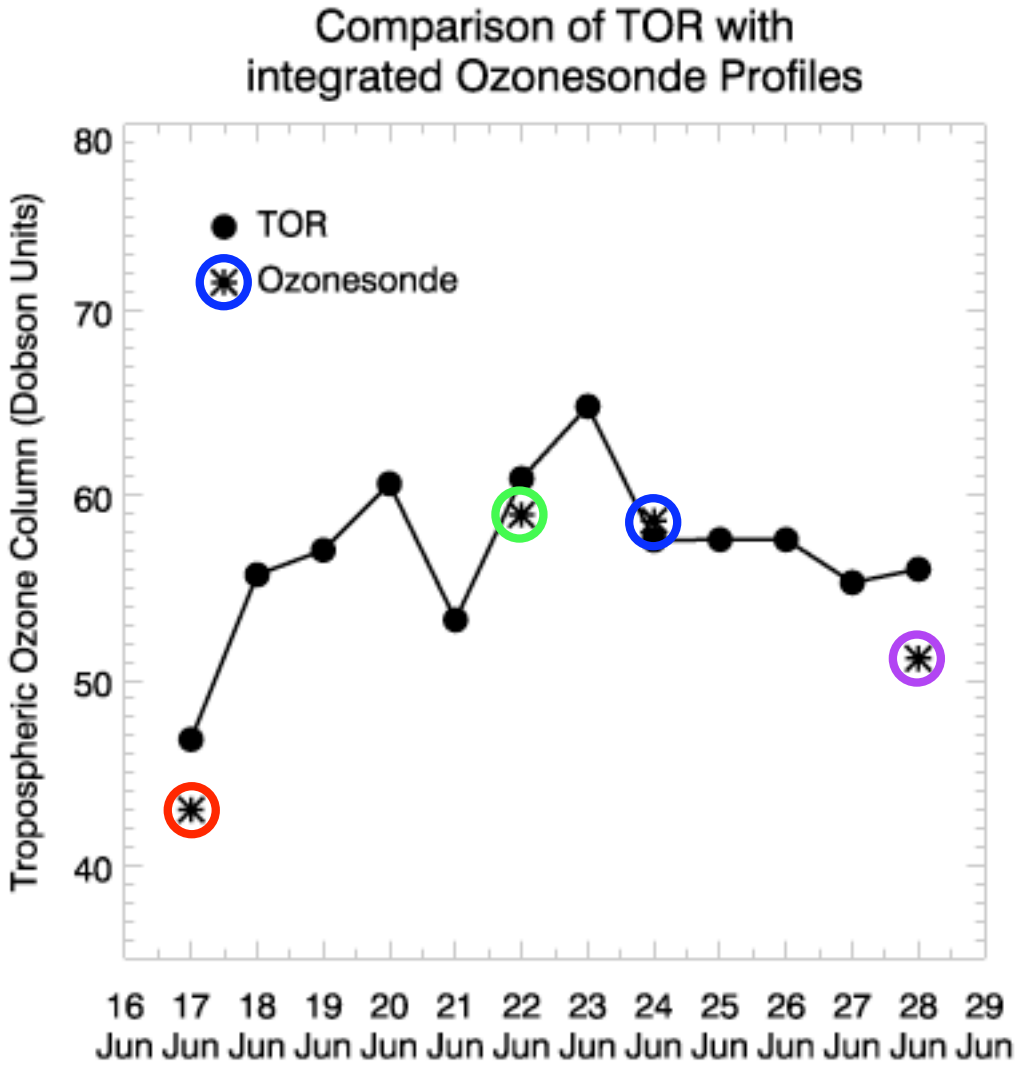
June 24



Good Agreement with Few Available Ozonesonde Measurements

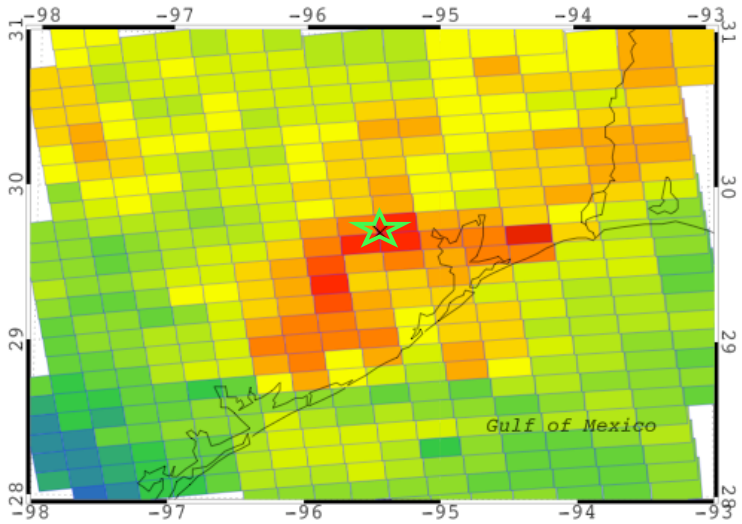
But Does It Tell the Whole Story?



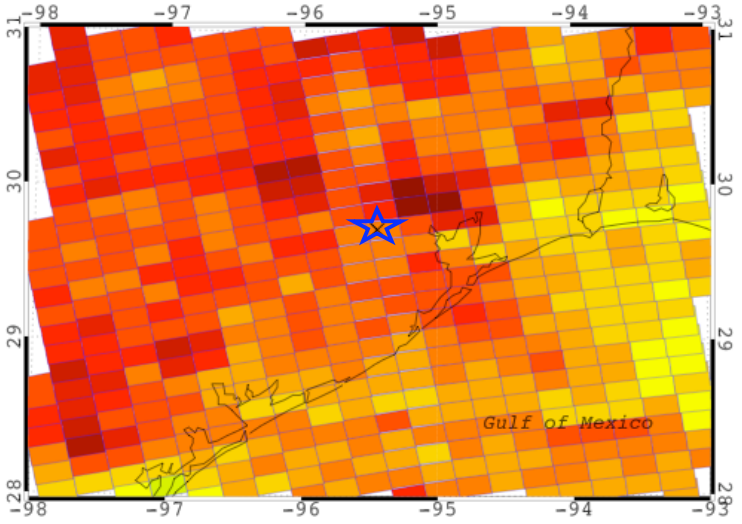


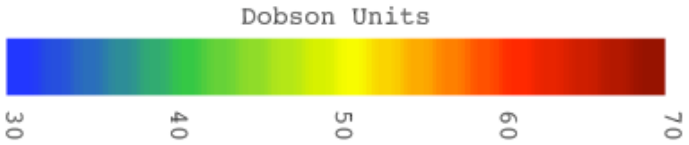
Derived TOR Pattern for the 2 Days Considerably Different

June 22, 2005



June 24, 2005





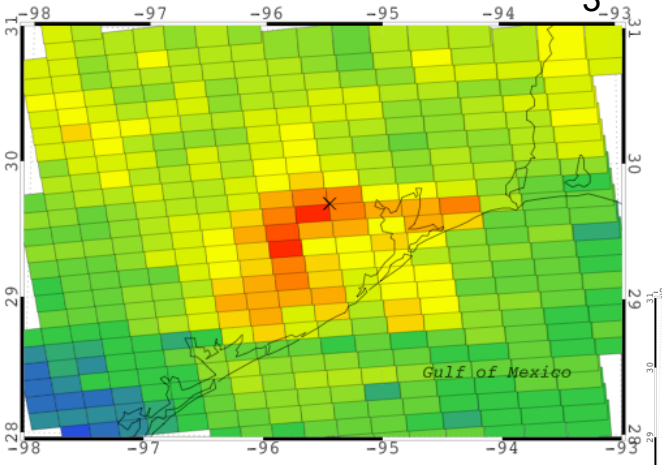
Comparison of June 22 & June 24 TOR Input Parameters

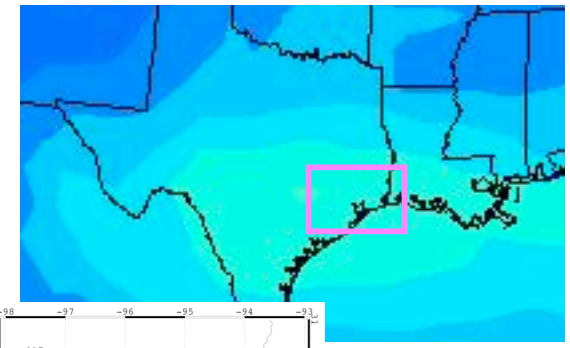
June 22

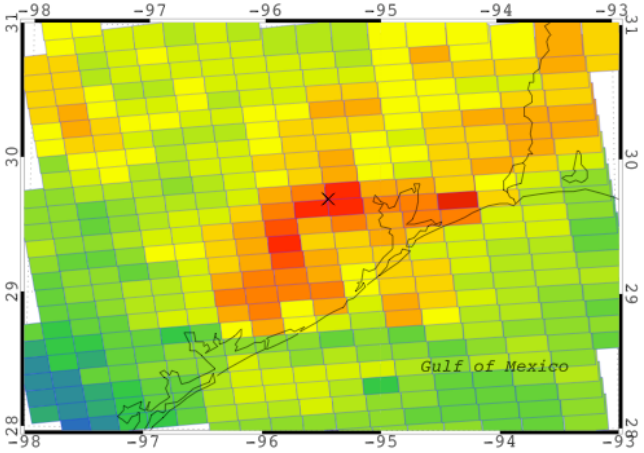
Total O_3

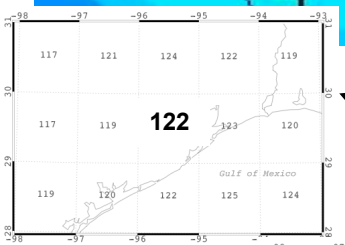
SCO

TOR

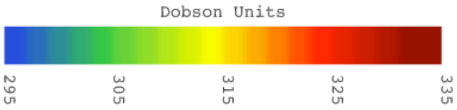


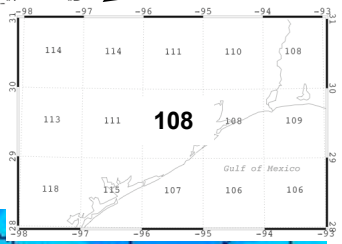


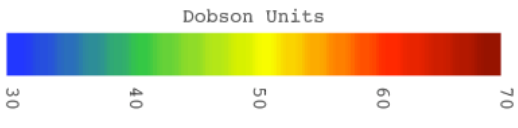


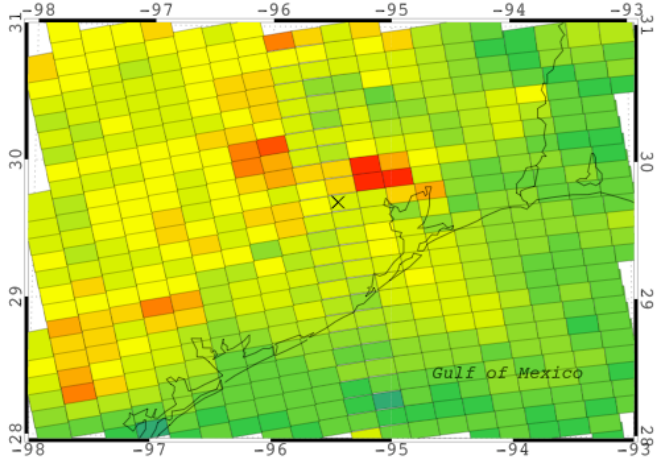


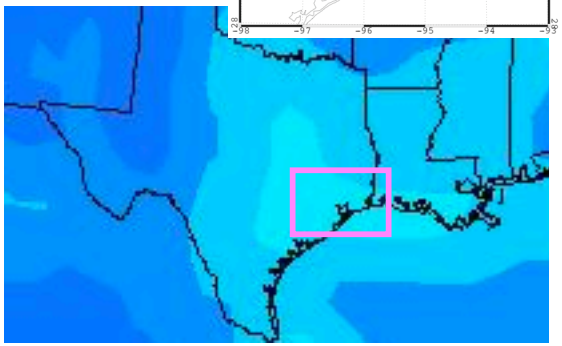
Tropopause Height (hPa)

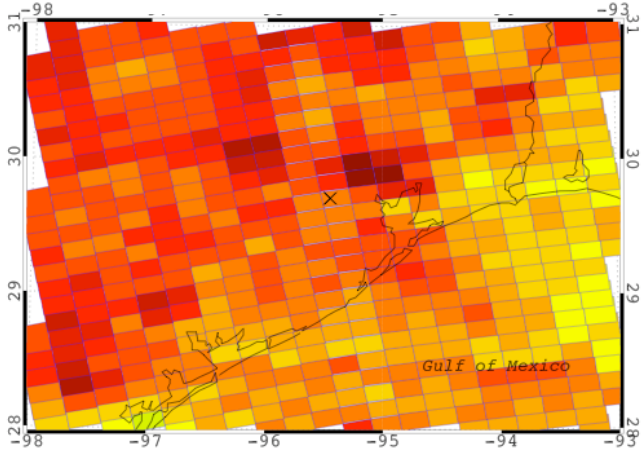






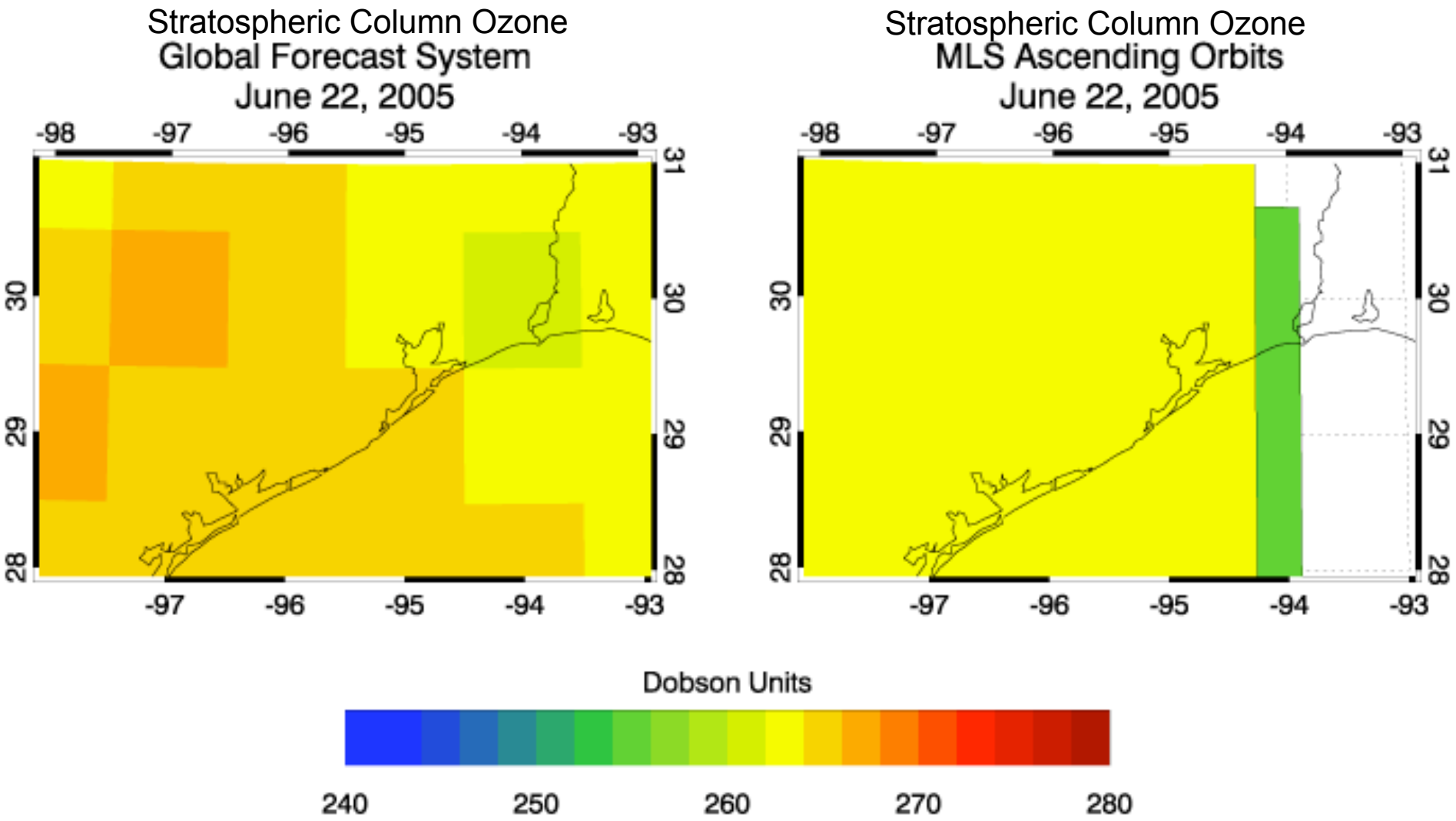






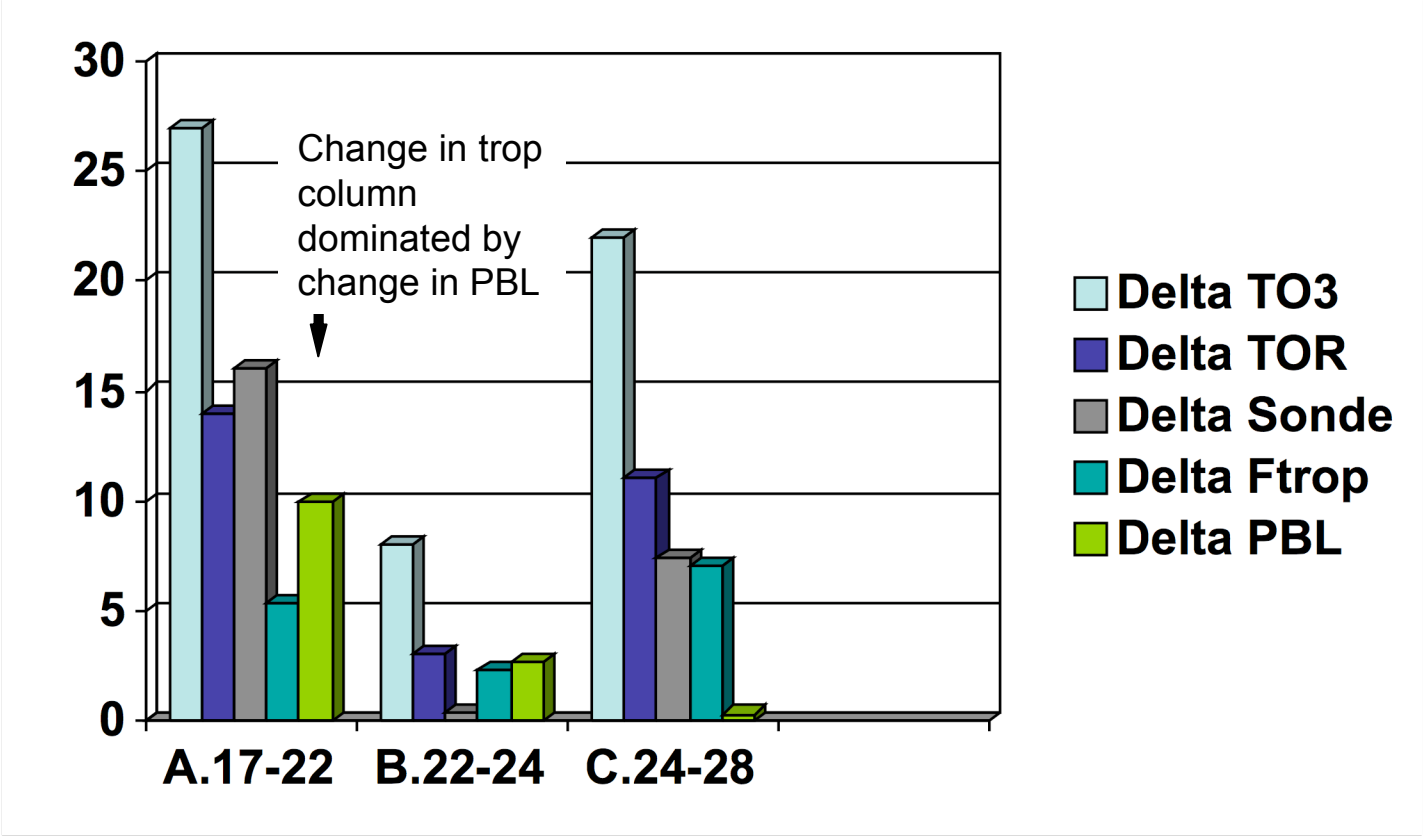
June 24

GFS Assimilated O_3 Provides Better Horizontal Resolution than MLS



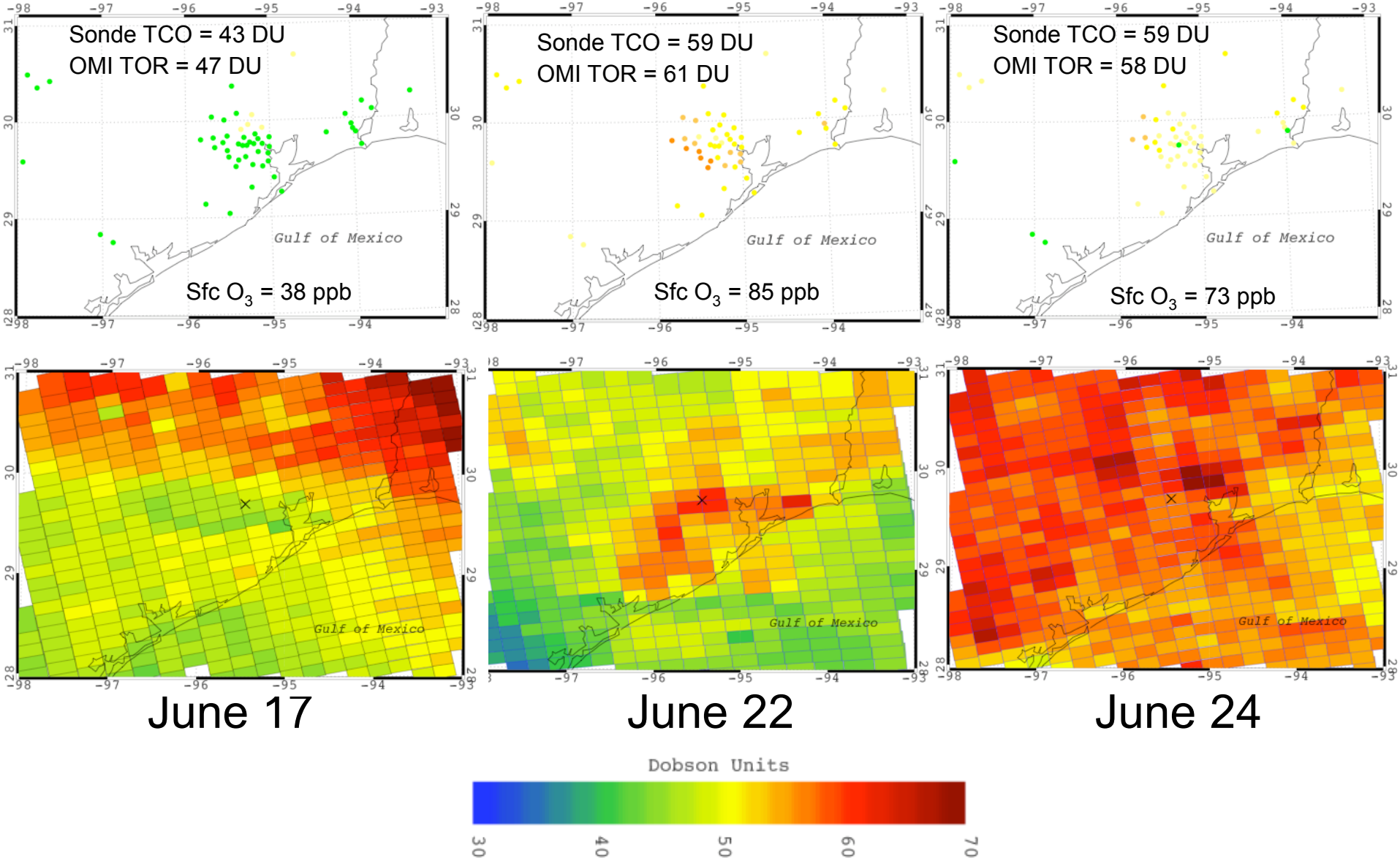
What Is Responsible for Day-to-Day Changes in Tropospheric Column Ozone?

Month	Day	Year	TOR	SONDE	TPH	SONDE
6	17	2005	46.8140	43.01(36.5+5.5)	104.290	113.17
6	22	2005	60.9151	58.94(41.8+17.1)	121.810	135.68
6	24	2005	57.6045	58.61(44.1+14.4)	109.560	135.01
6	28	2005	46.1507	51.18(37+14.1)	113.390	96.07



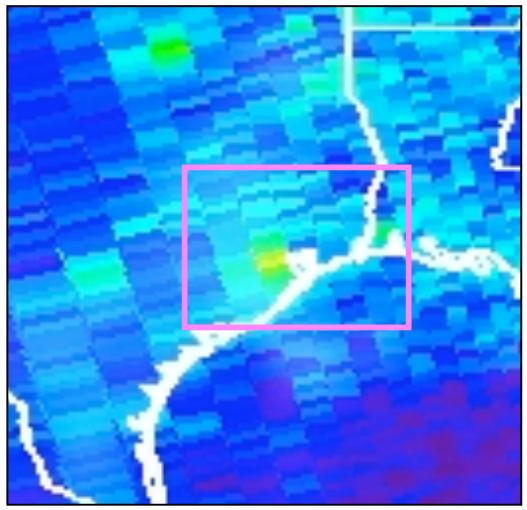
Surface O_3 and TOR Over Houston

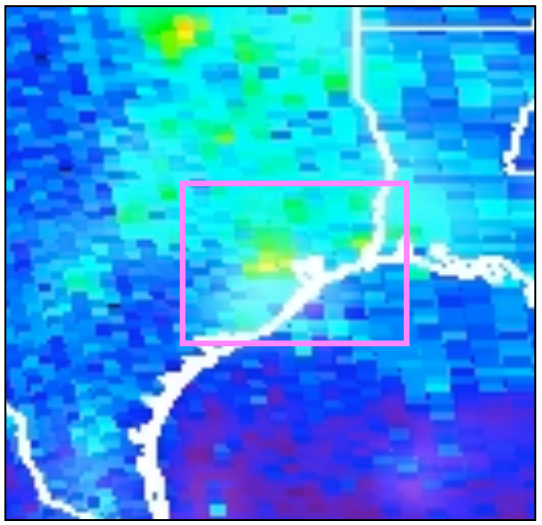
Is there an Obvious Relationship?

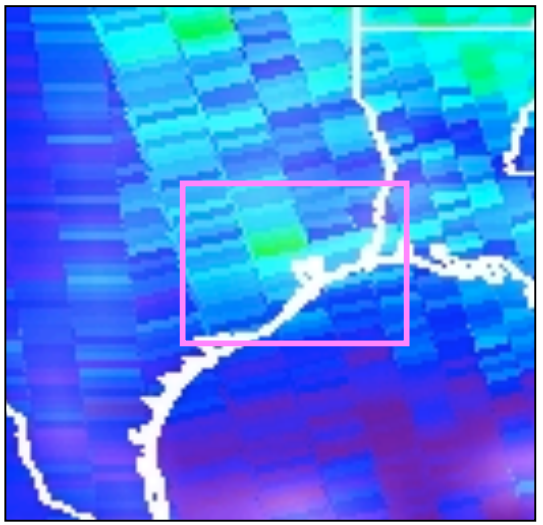


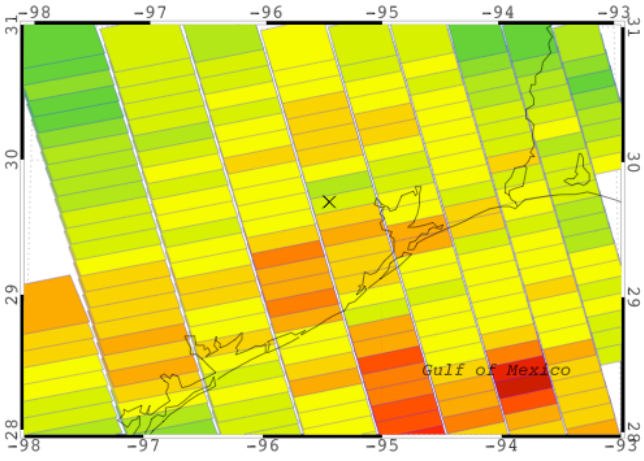
OMI NO_2 and TOR Over Houston

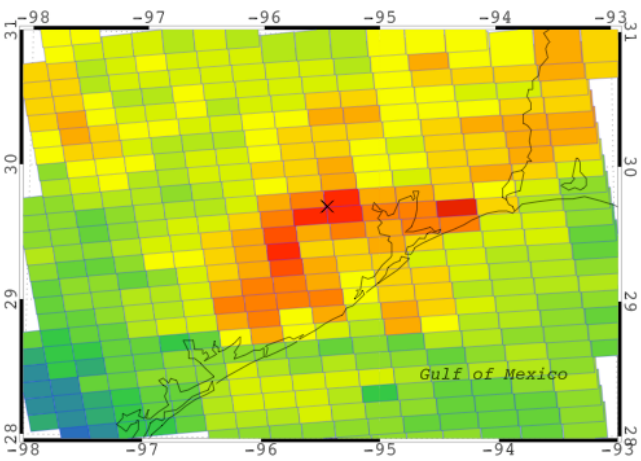
Can They Be Used Synergistically for Air Quality Studies?

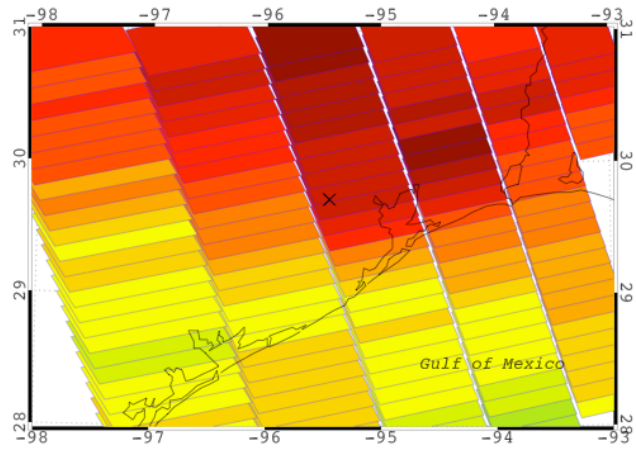








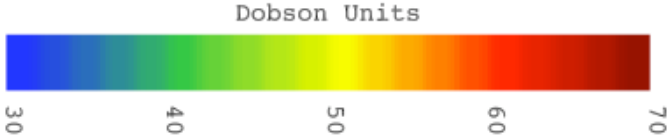




June 21

June 22

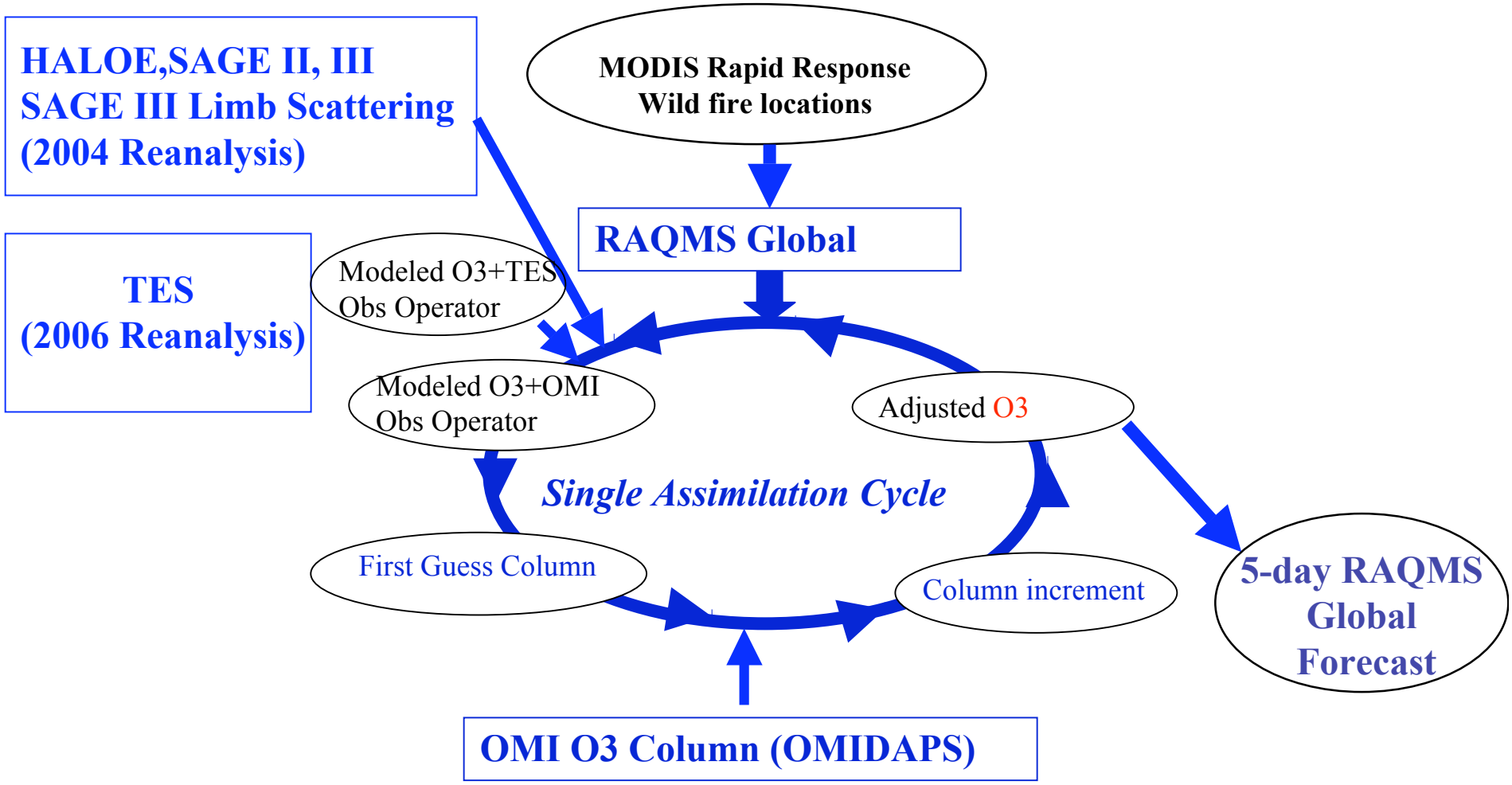
June 23



Part II: Assimilation During August 2006

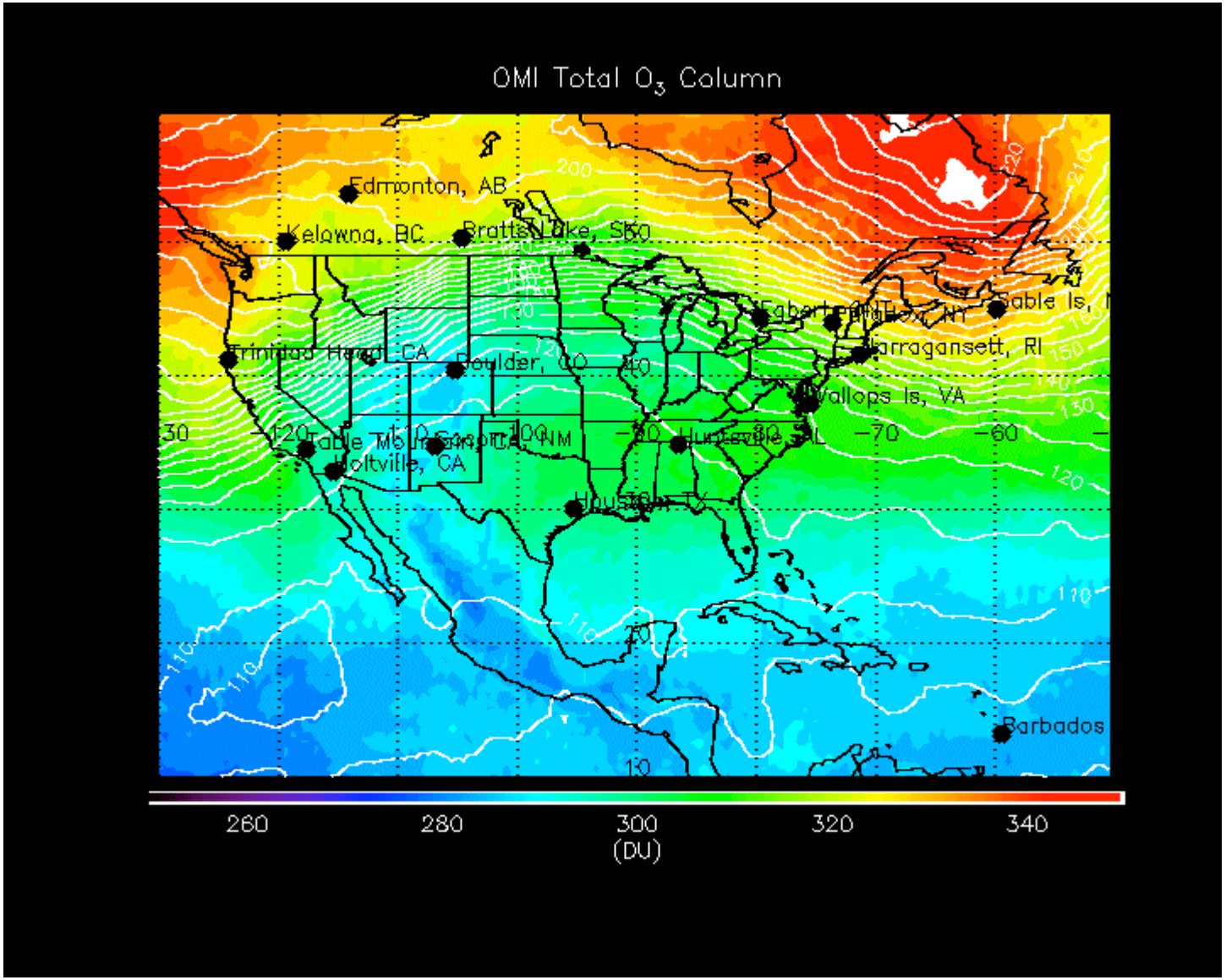
- Compare Model O_3 with Satellite O_3 & In situ O_3
  - Total Ozone
  - (Stratospheric Ozone)
  - Tropospheric Ozone (TOR)

RAQMS Ozone Assimilation/Forecast Procedure

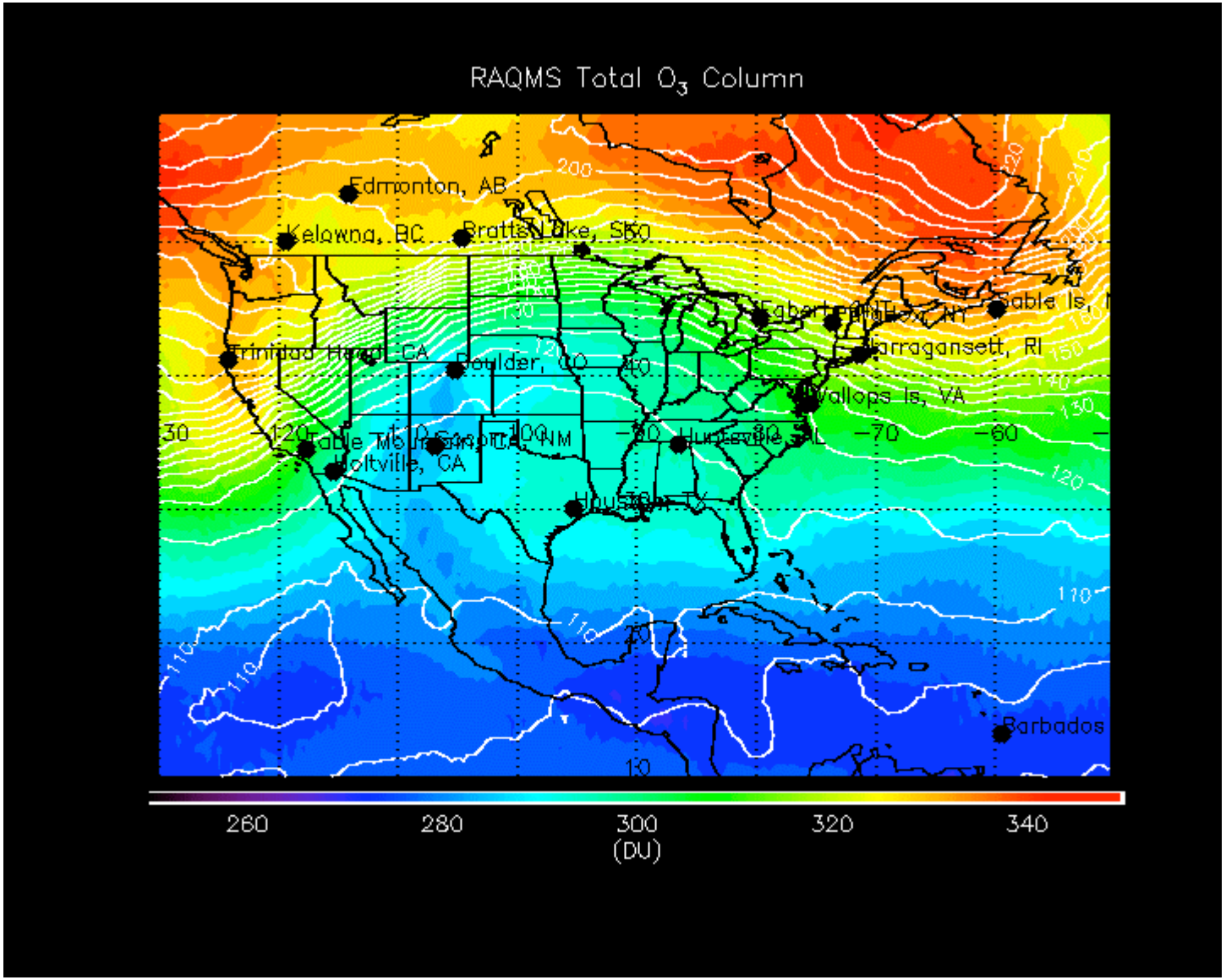


Realtime OMI Cloud-cleared column assimilation conducted at 2x2 degrees, analysis increment applied as percentage adjustment to mixing ratio resulting in minimal impact on troposphere.

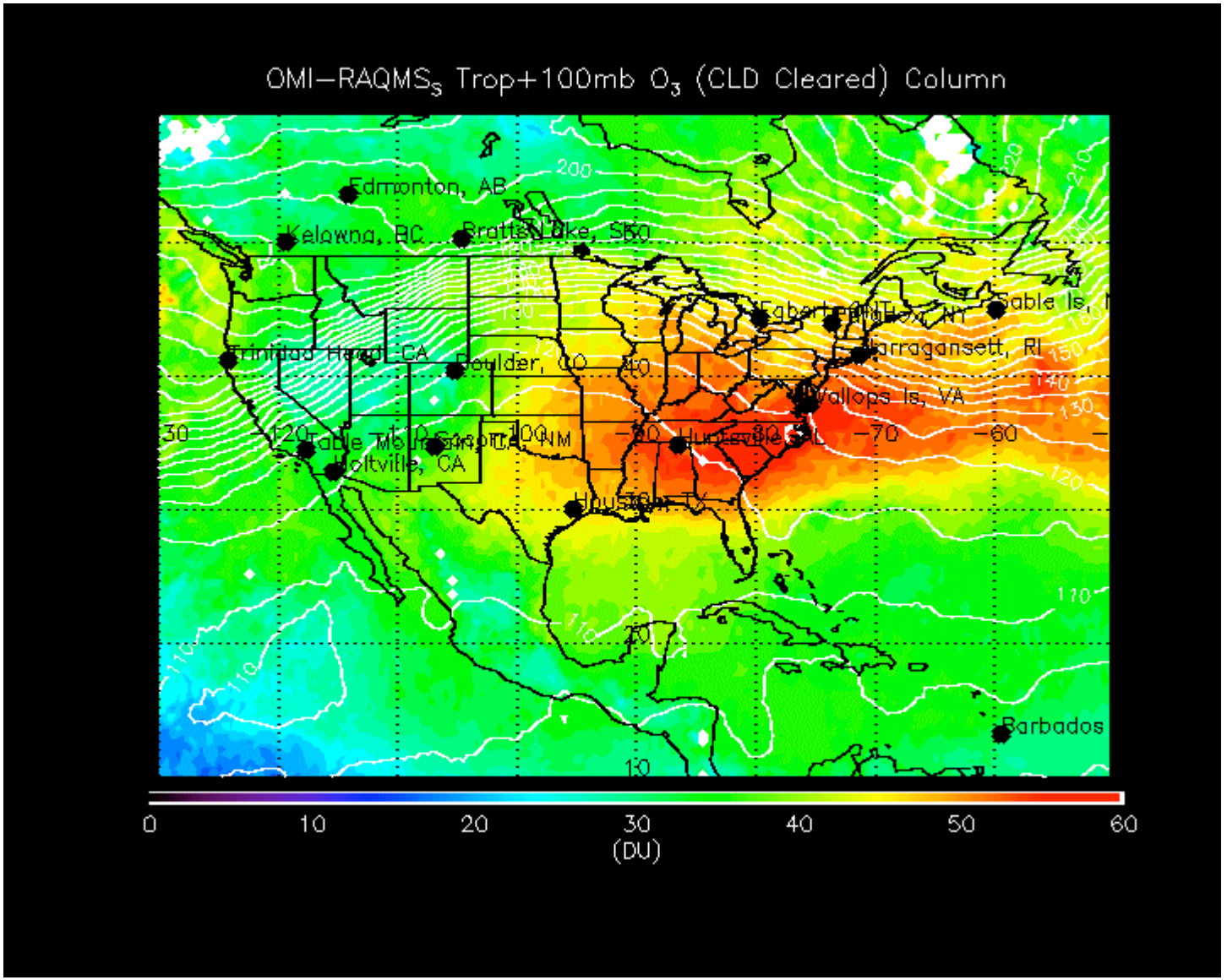
0.5°x0.5° Binned NRT OMI Column Ozone: August 01-24, 2006



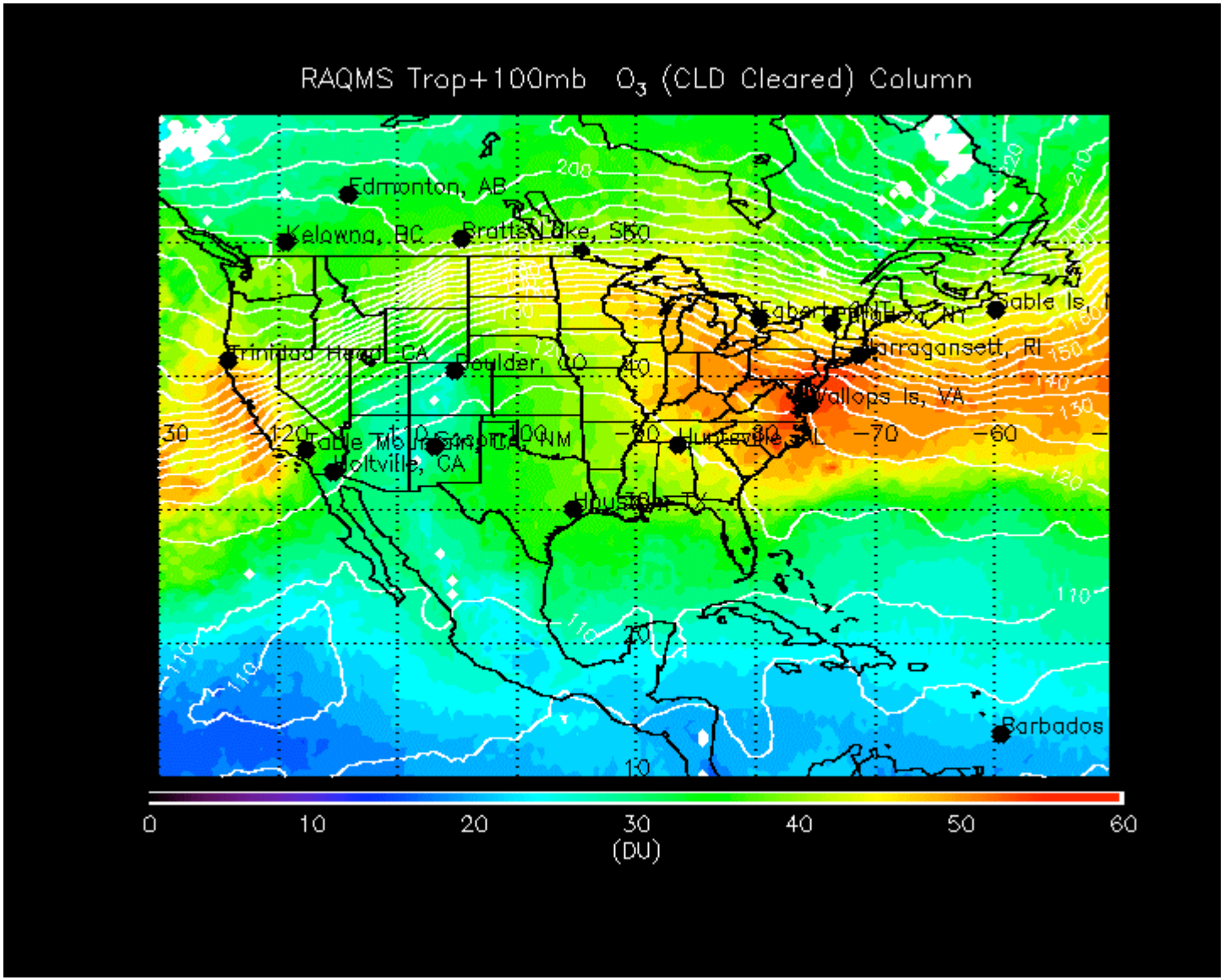
0.5°x0.5° Binned NRT RAQMS Column Ozone: August 01-24, 2006



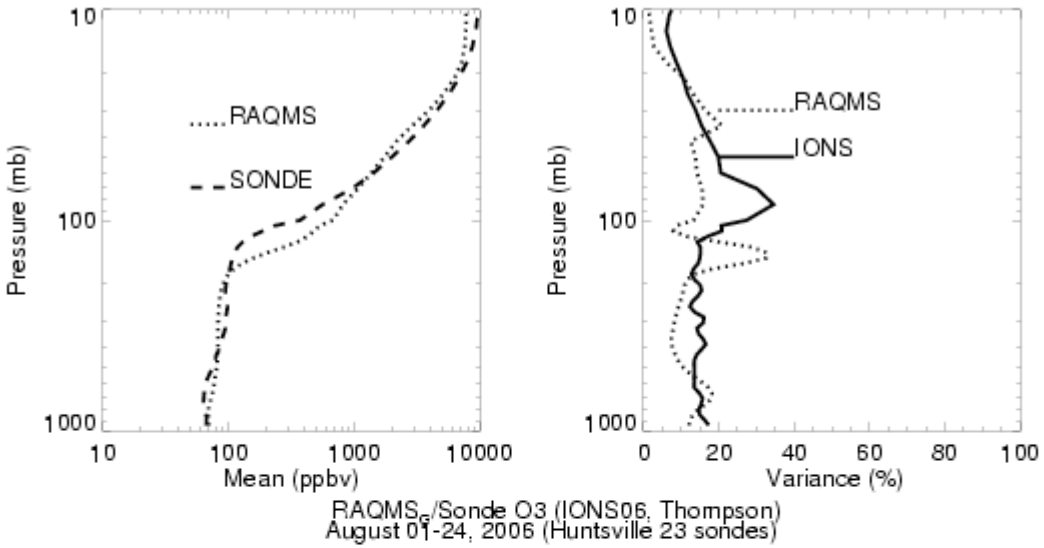
OMI-RAQMS$_{strat}$ cloud-cleared Tropospheric Ozone Column (TOC)
August 01-22, 2006

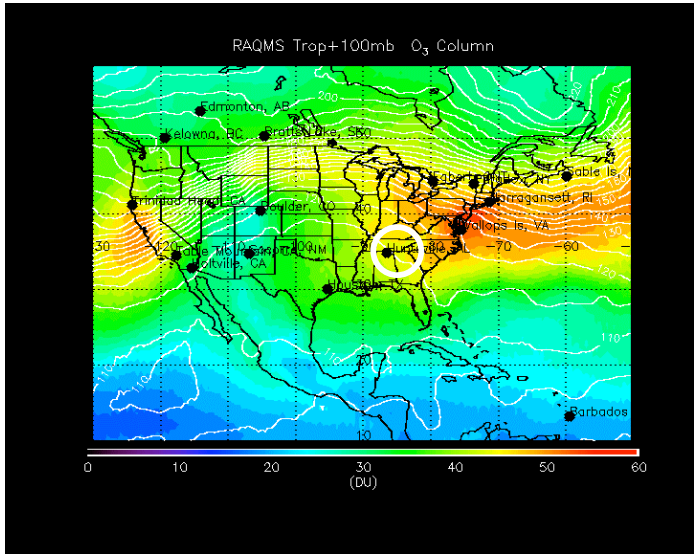


RAQMS cloud-cleared Tropospheric Ozone Column Analysis
August 01-22, 2006

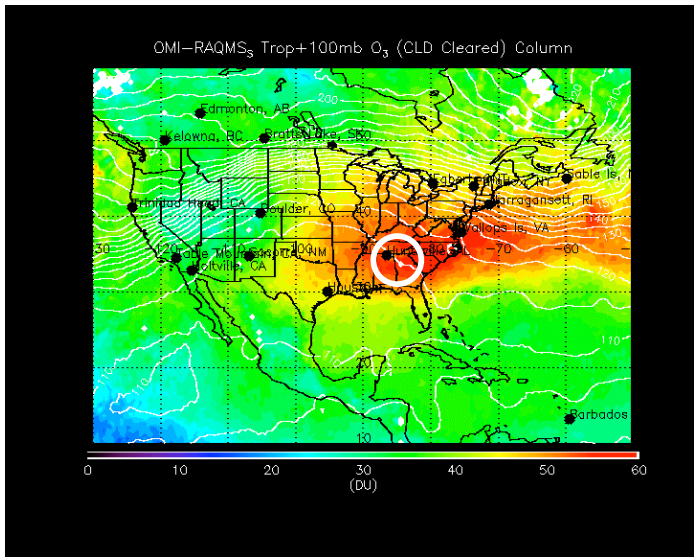


RAQMS/OMI Huntsville Validation

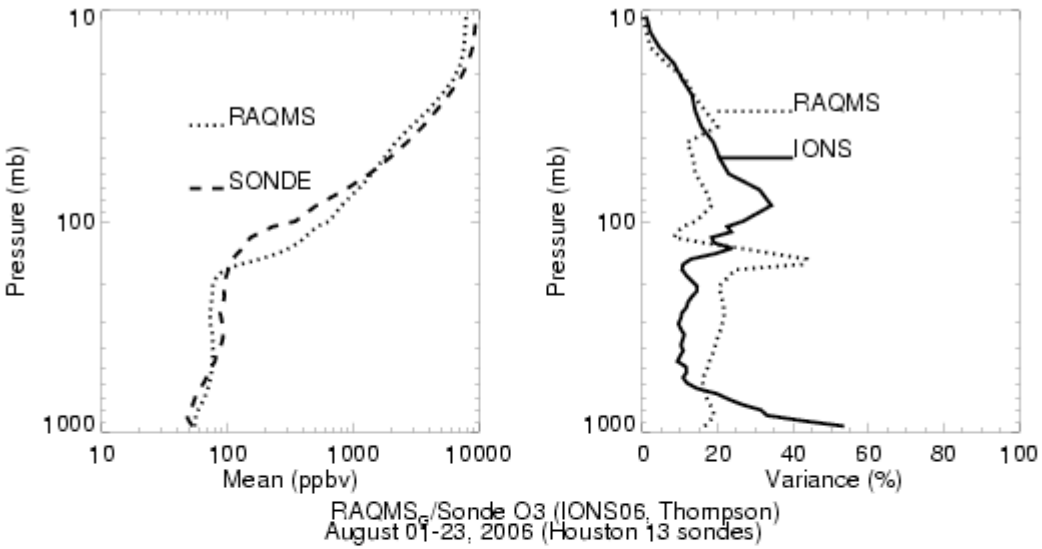


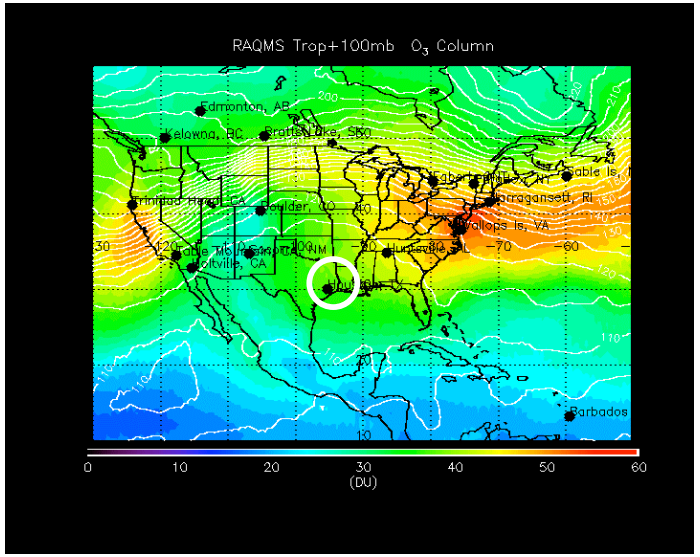


RAQMS shows no systematic bias relative to IONS06 below 215mb (Huntsville$_{trop}$=115mb).
This suggests that OMI-RAQMS$_{strat}$ TOC is overestimated at Huntsville

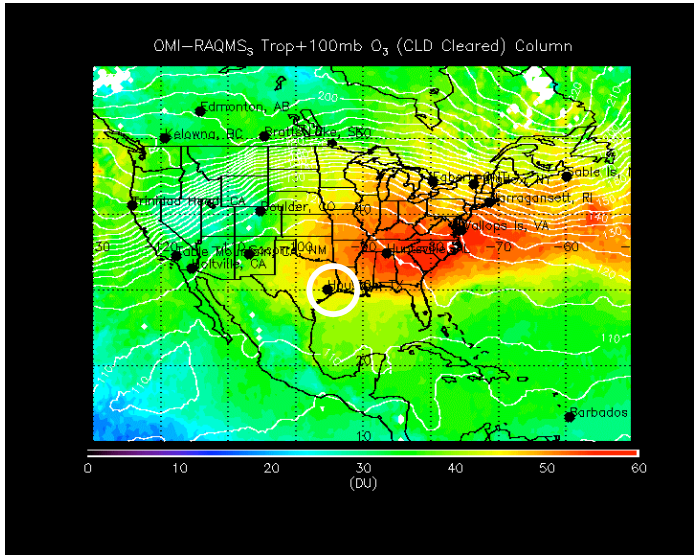


RAQMS/OMI Houston Validation





RAQMS shows no systematic bias relative to IONS06 below 212mb (Houston$_{trop}$=112mb).
This suggests that OMI-RAQMS$_{strat}$ TOC is overestimated at Houston



Summary of Part II

• RAQMS shows no systematic bias relative to IONS06 below 215mb at the middle latitude stations.

• RAQMS is generally higher in the lower stratosphere and lower in the upper troposphere relative to IONS06 ozonesonde data at northern middle latitudes

• OMI-Generated TOR using RAQMS to generate is higher than RAQMS generated TCO

• Future Considerations:
Comparison between GFS and RAQMS models needs to be understood